Portland Harbor Superfund Site
Portland, Oregon

Risk Management Decisions Required

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List of Abbreviations and Acronyms

Abbreviation/Acronym	Definition
AOPC	Area of potential concern
BERA	Baseline Ecological Risk Assessment
BHHRA	Baseline Human Health Risk Assessment
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cm	Centimeter
CSTAG	Contaminated Sediments Technical Advisory Group
CT	Central tendency
DDD	Dichlorodiphenyldichloroethane
DDE	Dichlorodiphenyldichloroethylene
DDT	Dichlorodiphenyltrichloroethane
DDX	2,4′ and 4,4′ isomers of DDD, DDE, and DDT
FS	Feasibility Study
g/day	Grams per day
HI	Hazard Index
HQ	Hazard Quotient
LWG	Lower Willamette Group
NOAA	National Oceanic and Atmospheric Administration
ODFW	Oregon Department of Fish and Wildlife
PAH	Polycyclic aromatic hydrocarbon
PCB	Polychlorinated biphenyl
ppb	Parts per billion
ppm	Parts per million
PRG	Preliminary Remediation Goal
RAL	Remedial Action Level
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
RM	River Mile
RME	Reasonable maximum exposure
ROD	Record of Decision
Site	Portland Harbor Superfund Site
SQuiRT	Screening Quick Reference Table
USEPA	U.S. Environmental Protection Agency

Portland Harbor: Risk Management Decisions Required for Successful Remedy Selection

1.0 INTRODUCTION AND GOALS FOR REMEDIAL ACTION

For more than a decade, the Lower Willamette Group (LWG) and U.S. Environmental Protection Agency (USEPA) have worked to assess conditions at the Portland Harbor Superfund Site (Site) through a Remedial Investigation and Feasibility Study (RI/FS). In that process, the LWG and USEPA have gathered massive amounts of data and undertaken substantial efforts to understand conditions at the Site. The LWG calculates that it has spent more than $90 million to date in this effort, not including additional staff time and other costs. This effort has shown that conditions throughout the majority of the Site do not pose unacceptable risks when considering the most common, realistic site-uses. The data also demonstrate that, except for certain localized areas that clearly require remedial action, the current concentrations of many substances in sediments are consistent with the *final* cleanup goals at other Superfund sites across the country.

Certain aspects of the RI/FS, however, have been driven by directives from USEPA not supported by site-specific information or any defensible rationale. As a result, the Site is now out of alignment with USEPA's other sediment sites nationally, and the process could lead to an unattainable and unworkable remedy unless appropriate decisions are made in the risk management process. Given Portland Harbor's economic significance for Portland and the surrounding region, these issues must be addressed now to avoid an undue burden on the community. None of the issues identified in this paper would require USEPA to redo any component of the RI/FS. Rather, by focusing on the more defensible scenarios during the risk management process, USEPA can still ensure that the site remedy is reasonable, achievable, and sustainable, while protecting human health and the environment.

2.0 EXECUTIVE SUMMARY

Key components of the RI/FS process at the Site to date have been directed by USEPA. Some of these directives conflict with available site-specific information and were issued without any significant explanation or scientific justification. These directives have impacted the risk assessments, background calculations, and other key components of the RI/FS process.

Risk Evaluation

Risk assessments are a critical component of the RI/FS. These assessments evaluate the potential risks posed by various exposure scenarios based on current site conditions. The resulting "risk values" provide a basis for comparing remedial alternatives. While risk assessments should incorporate conservative assumptions, all scenarios must be reasonable given known site uses. Unfortunately, certain scenarios evaluated at the Site were dictated by USEPA without any rational basis and are highly unlikely to occur. For example, USEPA required the risk assessment to include assumptions such as the following:

- Residents are eating 7,000 meals of exclusively carp, over a period of 30 years, all caught within the Site, and all of which are eaten completely uncooked, uncleaned, and whole, including skin, bones, and guts. Similar single-species diet assumptions were made for smallmouth bass and two other resident fish species.

- Residents are eating 900 meals of Asian clams (a species that usually grows no larger than the size of a nickel in the Pacific Northwest), all caught within the Site, and all of which are eaten uncooked and undepurated (i.e., unpurged) for 30 years.

Neither of these scenarios meets the standards for a risk assessment. The single-species diet is based on overly conservative, unfounded assumptions regarding fish consumption and cooking and preparation methods. The only information cited for clam consumption was an anecdotal statement that some transients reported eating clams occasionally. In the absence of site-specific data, USEPA based the clam consumption rate on shellfish rates from a nationwide survey. That survey, however, documented the consumption primarily of shrimp and did not support an assumption that anyone is consuming such large quantities of the nickel- and dime-sized clams at the Site. In fact, so few clams were found at the Site that the LWG was required to make 116 tows of a sediment trawl to collect just 371 of these tiny, rare clams—well under the monthly consumption amount cited for an individual in the Baseline Human Health Risk Assessment (BHHRA).

While various exposure scenarios were evaluated, these and other USEPA-directed scenarios generated the highest "risk" values. As a result, the most unlikely scenarios are the ones that could drive the risk evaluation for the Feasibility Study (FS). In fact, the purported risks calculated under these scenarios are orders of magnitude greater than those calculated for more likely scenarios. One of the reasons these scenarios generated such inflated values is that they are additive, with each compound assumption building on the next, until the final calculated "risk" value bears no relation to any actual risks posed to site users. For many scenarios, substituting just one reasonable assumption for an unreasonable one makes the difference between an unacceptable risk and a lower risk that may be acceptable.

Background Levels of Contamination

Since USEPA directives have skewed the highest purported "risk" values at the Site, preliminary cleanup levels for many of the risk scenarios described above may be less than background concentrations; however, the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) does not require sites to be cleaned up to levels less than background. As a result, the background calculation could become the *de facto* target for cleanup levels. Unfortunately, the background calculations also have been distorted:

- USEPA excluded all sediment data in a 3.5-mile stretch of the Willamette River immediately upstream of the Site from the background calculation. This blanket exclusion was unfounded. While some of these locations may have been impacted by nearby sources, the data should have been evaluated to distinguish any such outliers from usable data.

- Even for samples collected further upstream, USEPA censored the data. For polychlorinated biphenyls (PCBs), four locations were removed without providing sufficient justification for their assertion that these results are outliers.

USEPA's unsupported directive to ignore data dramatically lowered the background calculation for PCBs, ultimately causing USEPA to select an extremely low background level of just 17 parts per billion (ppb) for PCBs, which is even less than the quantification limit for older sediment data at the Site, and is an impractically low background for the Site.

Other Directives

USEPA also directed other aspects of the RI/FS without sufficient justification. For example, USEPA dictated the Preliminary Remediation Goals (PRGs) with little explanation of the rationale or process used. USEPA apparently borrowed PRGs arbitrarily from other guidance or regulatory programs. USEPA also dictated the locations and configurations of the areas of potential concern (AOPCs), which define the extent of sediments for which active remedial technologies must be evaluated. As a result, interested parties and the public can only speculate as to the process used to develop these key components of the RI/FS.

Out of Alignment With Other Sites Nationally

Given these USEPA directives, the Site is now out of alignment with other sediment sites nationally. Below is a comparison of the pre-remediation sediment concentrations and PRGs at the Site to the Remedial Action Levels (RALs) at other USEPA sites, demonstrating the vast disparity between USEPA's approach at the Site and other sediment sites. In fact, the PRGs for some key substances at the Site are orders of magnitude less than the cleanup levels at most other sediment sites. For example, the PRG for PCBs that USEPA selected for the Site based on the background approach described above is just 17 ppb. This level represents a tiny fraction of the cleanup levels at most sites and is less than one-seventh of the *lowest* PCB cleanup level at any sediment site in the nation. While final cleanup levels often are greater than PRGs, many of the PRGs at the Site are so low that they bear no relation to any reasonable cleanup levels.

This contrast is even more stark when cleanup levels at other sites are compared to the current, pre-remediation sediment concentrations at the Site. In fact, the current site-wide average concentrations of PCBs, polycyclic aromatic hydrocarbons (PAHs) and 2,4′ and 4,4′ isomers of DDX (dichlorodiphenyldichloroethane [DDD], dichlorodiphenyldichloroethylene [DDE], and dichlorodiphenyltrichloroethane [DDT]) already are within the range of concentrations that have been approved by USEPA for *final* cleanup levels at other sediment sites. Therefore, the Site already is cleaner for those substances on a site-wide average basis prior to any remedial action than any other sediment Superfund site. While the FS is still in development, the risk scenarios and background calculations could result in unreasonably low cleanup levels and a remedy that is technically unachievable unless more reasonable decisions are made during the risk management process.

It is critical that USEPA senior management address these problems now to avoid an undue burden on the Portland community and region. As discussed below, Portland Harbor is Oregon's largest seaport, a working harbor, and an economic engine for the Portland metropolitan area. Portland Harbor contributes to the local, regional, and national economies by providing employment, local and state tax revenues, federal customs fees, and business revenue. In 2010, more than 17,000 jobs were supported by activity in Portland Harbor, providing more than $1 billion in wages and local sales. Given the importance of Portland Harbor, agency actions that unreasonably impede the working harbor activities threaten to cause widespread damage to the Portland community and the region through lost jobs, lower wages, decreased property values, and increased taxes and fees. These implications should be considered in the risk management process.

USEPA still has the opportunity to ensure that the FS and remedy selection process achieve the goals of protecting health and the environment through technologically achievable and sustainable means without imposing unnecessary burdens on the community. To achieve this outcome, USEPA senior management must make appropriate decisions during the risk

management process based on defensible scenarios. In addition, the Contaminated Sediments Technical Advisory Group (CSTAG) should commence an immediate review of the Site during the FS process to ensure that USEPA's approach toward cleanup levels and remedial alternatives is consistent with its approach at other sediment sites. By making reasonable risk management decisions and implementing CSTAG's recommendations, USEPA can achieve a remedy for the Site that is reasonable, achievable, and sustainable as discussed below.

3.0 THE PORTLAND HARBOR RI PROCESS HAS BEEN DRIVEN BY DIRECTIVES FROM USEPA THAT ARE OUT OF ALIGNMENT WITH USEPA GUIDANCE AND ITS PRACTICES AT OTHER SITES

As part of the Remedial Investigation (RI) of the Site, the LWG has generated data and prepared various documents, including the BHHRA and the Baseline Ecological Risk Assessment (BERA). The BHHRA and BERA are critical components of the RI, calculating the risks to human health and the environment based on current site conditions. The BHHRA and BERA, therefore, provide a basis to evaluate remedial alternatives, with the overall goal of reducing risks to human health and the environment. While a risk assessment should present a conservative evaluation of risk, the assumptions must relate to actual site conditions and represent what is reasonably expected to occur at the Site.

Unfortunately, key portions of both the BHHRA and BERA at the Site fail to meet this standard. Portions of both documents have been directed by USEPA which has insisted on the inclusion of overly-conservative assumptions unsupported by scientifically-defensible, site-specific information. As a result, the purported risks identified in the BHHRA and BERA are greatly inflated, with the highest risk values bearing no relationship to the current or future site conditions. These scenarios therefore undermine the legitimacy and usefulness of the BHHRA and BERA in the FS process. These inflated risk values also generate unnecessary confusion and undue alarm for the public, who should be able to rely on the accuracy of these documents during the public participation process. As discussed below, when one focuses on the risk scenarios more in-line with reasonable, documented, and sustainable site use, the baseline risks for the Site already are largely at or less than USEPA's accepted risk limits.

3.1 The Highest Purported Risks Presented in the Portland Harbor BHHRA are Based on Unreasonable Assumptions Unsupported by Site-specific Information

A BHHRA is an analysis of the potential adverse health effects caused by a release of hazardous substances at a particular site. The BHHRA is an integral component of the RI/FS process, providing a foundation for evaluating remedial options consistent with CERCLA.

Each exposure scenario assessed in a BHHRA is calculated based on a reasonable maximum exposure scenario (RME Scenario) and a central tendency scenario (CT Scenario). These terms are defined as follows:

- RME Scenarios are "…the highest exposure that is *reasonably* expected to occur at a site...under both current and future site use conditions" [emphasis added] (USEPA 1989). For example, one may assume based on available information that a certain portion of the population is consuming a certain number of meals of a specific type of fish over a given period of time. Based on the results of that calculation, one then would assess the health risks relating to fish consumption based on levels of contaminants in the fish. Values derived from such RME Scenarios then provide a

scientifically-defensible foundation for identifying and assessing risk associated with the Site and remedial options.

- CT Scenarios, in contrast, are intended to reflect average exposures (NRC 1994). The CT Scenario therefore is designed to assess a more average or typical exposure scenario, with intake or exposure assumptions that are lower than those used in the RME Scenarios. CT Scenarios should be considered when making risk management decisions at a site (NRC 1994), as these scenarios provide information on what a typical site user's risk might be.

Because the RME is designed to be most conservative, it is the most subject to speculative guesswork under the umbrella of capturing the upper end risks of the Site; however, the RME must be based on *reasonable* assumptions. Scenarios that are largely speculative or lack grounding in site-specific information are not proper RME Scenarios and should not be used in a BHHRA. In fact, it is critical that reasonable and defensible RME and CT Scenarios are applied. The values calculated in the BHHRAs are intended to provide both risk managers and the public with an accurate assessment of the potential health threats from exposure to hazardous chemicals at a site. Risk managers then use these BHHRA outcomes as a basis for evaluating the costs and benefits of different remedial options and assessing which remedial options provide the best "value" in reducing risk. The results of the BHHRA also are used in developing PRGs, initial cleanup goals that are used to assess the feasibility of remedial options in the FS at the Site. Since the BHHRA is intended to provide a foundation for critical remedial decisions, the values calculated by the RME Scenario that are not reasonable or supported by site-specific information could cascade through the process, corrupting subsequent calculations and undermining the validity of the remedy selection.

Unfortunately, the Portland Harbor BHHRA does not present a reasonable assessment of risks posed to human health because the highest risk scenarios fail to meet the RME and CT standards. The BHHRA includes numerous scenarios for potential exposure for dockside workers, in-water workers, transients, adult and child recreational beach users, tribal fishers, recreational fishers, and divers. The scenarios that are generating the highest risk values are fish consumption scenarios. While the RME and CT Scenarios should be based on reasonable, site-specific information, the calculations that generate the highest risk values in the BHHRA for the Site instead were driven by directives from USEPA, requiring the use of overly-conservative assumptions not supported by site-specific information. Because these overly-conservative assumptions are compounded, the highest values generated in the BHHRA do not constitute a legitimate assessment of risks posed by the Site.

A few examples of the unreasonable risk scenarios assessed in the BHHRA are discussed below, including USEPA directives requiring the use of "single species diet" scenarios, the non-existent pathway of Asian clam consumption, and the method for compounding these and other unreasonable assumptions. Such assumptions and methods distort the actual risk. Even so, only some of these scenarios indicate unacceptably high risk regardless of the range of assumptions within the scenario. Instead, most indicate a continuum of risk. Moreover, if just a few unreasonable assumptions are corrected to present more reasonable scenarios, most of the highest risk calculations would be reduced by at least an order of magnitude.

3.1.1 The Single-species Adult Fish Consumption Scenarios That Generate the Highest Risk Values are Not Based on Reasonable, Site-specific Information

The fish consumption scenarios in the BHHRA include various assumptions regarding the types of fish consumed, fish consumption rates, the "species fraction" (the portion of the diet made up of a single fish species), cooking/preparation methods, and the "site fraction" or "site use fraction" (the portion of an individual's diet comprised of fish caught from within the Site, or in some cases, from a specific river reach within the Site). Since the values assigned to any of these factors could alter the calculated risk dramatically based on overestimation of the total diet from one scenario, it is critical that realistic assumptions are applied. Unfortunately, many of the assumptions required by USEPA in the fish consumption calculations in the BHHRA are neither reasonable nor site-specific.

The highest risk values generated in the BHHRA for the Site are those based on USEPA-directed fish consumption scenarios for invasive, non-native, warm-water species such as carp and bass, which are not native to the Willamette River. Carp, in particular, generates higher risk values under the scenarios described below due to measured contaminant concentrations in whole body samples. The BHRRA includes numerous scenarios based on the implicit and unsupported assumption that the populations of these invasive fish within the Site could sustain extremely high, long-term consumption rates, both now and in the future. Importantly, smallmouth bass consumption, identified in the FS process as an important PRG, share the same unrealistic assumption as carp and unnecessarily bias the risk assumptions and resulting RALs.

Moreover, the human risk values calculated for these invasive species were not derived from reasonable, site-specific information, but instead were based on overly-conservative, unfounded assumptions regarding fish consumption, species fraction, site fraction, and cooking/preparation method. The following consumption exposure assumptions highlight this point:

- **Preparation**. For both the carp consumption scenario and the bass consumption scenario that result in a PRG, the BHHRA assessed the risks posed by consuming 7,000 meals of fish over a period of 30 years, all exclusively composed of carp or bass, all caught from within the Site, and all of which are consumed completely raw, uncleaned, and whole (including organs and bones). This unfounded assumption overestimates risks for two reasons. First, preparation techniques are likely to vary with some cooking techniques utilizing the whole fish and others only utilizing portions, such as fillets. An individual would not limit preparation to exclusively one technique, especially over a 30-year period. Second, as indicated in USEPA guidance, preparation methods and parts of fish consumed impact the levels of residual contamination in fish meals (USEPA 1997). Most preparation methods include the removal of skin, organs, and/or fat, which are the parts of the fish that tend to accumulate contaminants more readily. This decrease in exposure through typical food processing techniques is well documented in the scientific literature, such as Skea et al. (1979) and Zabik et al. (1996), among others, also summarized in USEPA 1997.

- **Consumption**. The fish consumption scenario including the resulting smallmouth bass PRG are based on the assumption that an individual will consume 7,000 meals of fish (again, raw, uncleaned, and whole) over a period of 30 years, all caught from the Site. This consumption rate was included in the BHHRA at the direction of USEPA to represent an upper-bound limit to risks, thus "bracketing" risks calculated using more reasonable and site-specific assumptions; however, it is inappropriate to use such

overly-conservative hypothetical consumption rates to develop remedial goals, which appears to be the case for smallmouth bass. Additionally, there is no credible information indicating that smallmouth bass caught within the Site constitute a significant portion of anyone's diet. Given the number of species and water bodies in the vicinity of the Site, an individual's fish consumption is more likely to include multiple species from multiple sources.

The individually-conservative assumptions described above are then multiplied together in the BHHRA, resulting in an exposure scenario that is more conservative than is reasonably expected to occur at the Site. The resulting exposure scenario is more conservative than an RME (reasonably maximally exposed) individual. As a result, fish consumption scenarios generate the highest risk values, and are therefore the primary contributors to purported risks for the Site. In fact, the purported risks posed by fish and shellfish consumption were determined to be orders of magnitude greater than other risks such as direct contact with sediment, surface water, or groundwater seeps.

The calculated risk values from fish and shellfish consumption derived using these unreasonable assumptions exceeded the USEPA target cancer risk range of 10^{-6} to 10^{-4} and target Hazard Index (HI) of 1 (a measure of how chemicals exert toxic effects). In contrast, direct contact with sediment, surface water, and seeps results in risks within or less than the USEPA target carcinogenic risk range of 10^{-6} to 10^{-4} and less than the target HI of 1, which includes commercial divers, recreational beach users, and transient beach and groundwater exposures. Since the highest calculated risk drives the overall presentation of risks, the unfounded assumptions underlying these calculations not only inflate the risks posed by these particular scenarios, they also threaten to skew the overall results of the BHHRA. Given that the primary fish that is caught for consumption in the Willamette River is salmon, overstating the risks from eating fish on the basis of unreasonable assumptions based on bass or carp may unnecessarily alarm the public.

3.1.2 The High-risk Values Generated from Clam Consumption Scenarios are Based on Speculation Regarding a Nonexistent Pathway

The Portland Harbor shellfish scenario that generates the greatest cancer risk value is based on the assumption that people are consuming approximately 900 meals over 30 years of raw, undepurated (i.e., unpurged) clam tissue all caught within the Site. Once again, USEPA directed that this clam-consumption risk scenario be included in the BHHRA. As with the carp consumption scenario, the clam consumption scenario is wholly unreasonable given site-specific considerations.

The only clam species assessed in the Study Area is *Corbicula fluminea (C. fluminea),* sometimes called the "Asian Clam." The Asian clam is an invasive, soft-shell clam introduced to Portland Harbor from Asia during the 1900s. Most of these clams, however, grow no larger than the size of a nickel. Even if it were feasible for these small clams to be collected as a food source, such Asian clams are on the prohibited species list of the Oregon Department of Fish and Wildlife (ODFW) rules regarding the importation, possession, confinement, transportation, and sale of non-native wildlife (ODFW 2011) and are, in fact, illegal to collect. Moreover, they occur in such low numbers in the Site, the LWG had great difficulty collecting sufficient clam tissue for analysis.

Photographs of *Corbicula fluminea.*

The only information cited in the BHHRA regarding purported shellfish consumption are a few statements purportedly made by transients during anecdotal interviews by a community group. A small number of transients reported eating clams from the river with some of those transients also reporting that they were in the area temporarily, moving from location to location frequently, or have variable diets based on what is easily available. This does not establish that anyone is routinely, let alone frequently, consuming clams from the Site. Such anecdotal, unverified references do not provide a scientifically-defensible basis for concluding that such consumption occurs within the Site in a manner that could result in a meaningful human health risk to anyone. Using this type of anecdotal evidence as justification for evaluation of an exposure pathway undermines the legitimacy and credibility of the BHHRA. Nonetheless, USEPA directed that the BHHRA treat clam consumption as a legitimate pathway to be assessed for purported exposure risks.

In the absence of site-specific data on clam consumption, the BHHRA imported the more general shellfish ingestion rates from a nationwide survey that identified rates including 18 grams/day (g/day; USEPA 2002a). The 2002 USEPA survey, however, is not applicable to clam consumption at the Site. In the 2002 USEPA survey, shrimp accounted for more than 80 percent of the fish consumed, almost no crayfish consumption was documented, and no freshwater clam consumption occurred. In the Portland Harbor Study Area, there are no shrimp, nor is there any formal documentation of any ongoing shellfish consumption anywhere in the Portland Harbor Study Area other than the anecdotal, unverified references described above, and possible crayfish consumption.

The wet weight of uncooked tissue in a typical *C. fluminea* clam is 0.5 to 0.7 grams, meaning that 18 g/day of uncooked clam tissue is equivalent to 26 to 36 clams. Over a month, an individual would have to find, harvest, shuck, and eat (raw and unpurged) 780 to 1,080 clams. Over a 1-year period, the total climbs to about 9,500 to 13,100 clams, and for the assumed 30-year exposure period, the individual would need to find, harvest, shuck, and eat about 285,000 to 395,000 clams.

Even if defensible information of clam consumption had been identified, the assumption that anyone is consuming 900 meals of this tiny clam, all caught within the Site, defies reason. As noted above, the LWG went to extraordinary lengths to capture sufficient clam tissue for analysis. Systematic efforts to collect sufficient numbers of the clams for laboratory analysis

during Round 3 of the RI resulted in the collection of only 371 clams from 7 locations within the Site. The clams were collected using a 25-foot boat with a 454-horsepower engine equipped with a stern-mounted davit and hydraulic winch necessary to tow a benthic sledge (designed to drag through the surface sediment along the riverbed). In all, 116 tows were conducted to collect the 371 clams. No clams were retrieved in 20 of the tows, and only 5 of the 116 tows produced more than 10 clams.

The low density of *C. fluminea* encountered within the Site during sampling efforts indicates that the resource is insufficient to support the exposure scenario used in the BHHRA. The scenario is made more unrealistic by the poor emersion (i.e., out of water) tolerance characteristics of *C. fluminea*. In this case, emersion occurs when the nearshore riverbed is exposed to the atmosphere as a result of falling river stage, thus depriving clams living in or on the sediment surface the ability to obtain nutrients and oxygen from an overlying water column. The anecdotal information supporting the exposure scenario is based on an assumption that the clams would be obtained by transients (or others) from shoreline areas, but survival for emersed *C. fluminea* is limited and, due to river level fluctuations, *C. fluminea* densities in shoreline areas would be expected to be low due to mortality caused by frequent emersion. The low density of the highly competitive *C. fluminea* as well as native bivalve species within the Site suggest that physical characteristics are in general the primary limiting factors of bivalve populations.

Therefore, there is no basis for assuming that anyone is eating the RME quantity of clams raw and undepurated. If during the FS analyses, any remedial action winds up being driven by protection of clam and crayfish consumption—an unfounded, hypothetical pathway—USEPA will have a difficult time defending this rationale to both the public and performing parties.

3.1.3 The Compounding of Overly-conservative Assumptions Directed by USEPA has Significantly Skewed the Results of the BHHRA

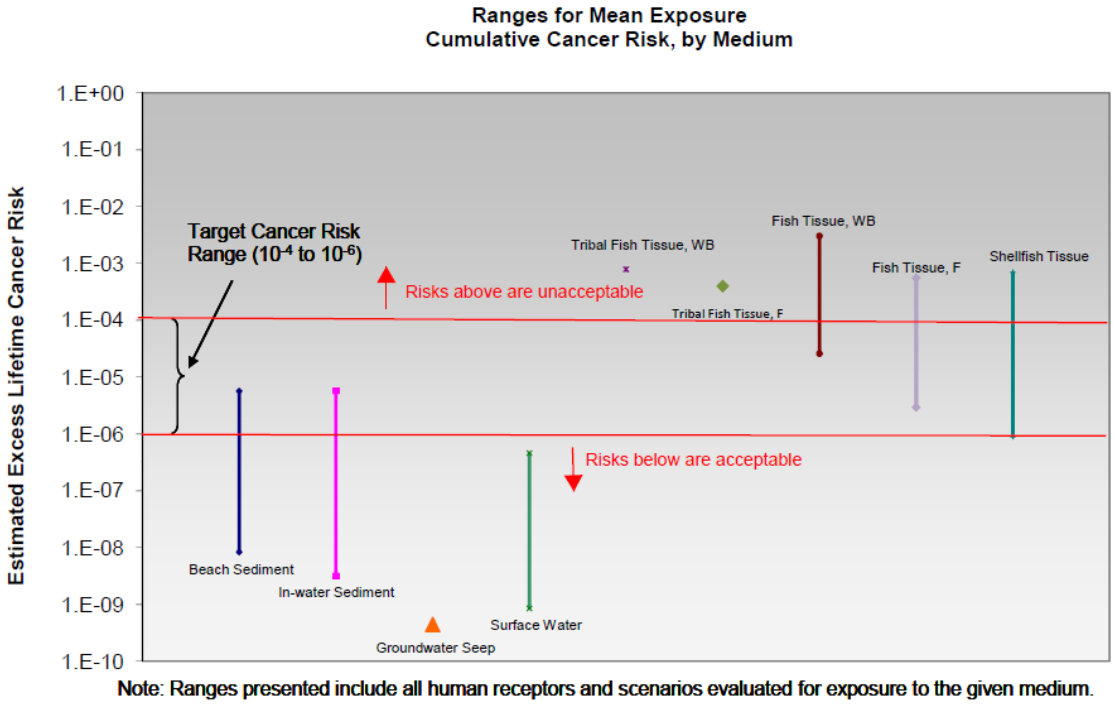
As noted above, each of these non-site-specific, overly-conservative assumptions compounds with the other assumptions to lead the BHHRA further off track from any reasonable assessment of the actual risks. As a result, the ultimate risk values are being driven by the most extreme assumptions.

For many of the scenarios in the BHHRA, the calculated risk would decrease dramatically if site-specific exposure parameters or assumptions are employed. One example of this difference is a comparison between the risk posed to an adult by ingestion of raw, whole body carp at the highest ingestion rate and upper statistical limit with ingestion of raw fillets of multiple species at the lower ingestion rate using a mean statistic. The calculated carcinogenic risks for those two scenarios are 2×10^{-2} and 7×10^{-4}, respectively. Therefore, the risk for the highly conservative scenario (eating whole carp exclusively) is approximately 1.5 orders of magnitude *greater* than the more probable, realistic scenario (eating fillets of different fish species) over a lifespan. In other words, the calculated risk would have been reduced more than 97 percent if more reasonable assumptions had been applied.

The RME Scenarios for clam consumption also illustrate the significant skewing effect of just one or two overly-conservative assumptions. As noted above, the few anecdotal references in materials cited in the BHHRA to purported clam consumption do not provide a basis for an RME Scenario. Nonetheless, even if defensible information of clam consumption had been identified, and people actually were consuming a significant amount of clams all caught exclusively within the Site, the calculated carcinogenic risk for this scenario would be reduced by an order of

magnitude from 3 x 10^{-4} to 2 x 10^{-5} if we assume, merely, that the clams are cleaned (i.e., depurated) and that the consumption rate is reduced to a still-high level of 3.3 g/day.

In fact, by substituting just one or two reasonable assumptions and holding all the other very conservative assumptions steady, the risks for many of the scenarios are reduced more than an order of magnitude. In many instances, substituting just one reasonable assumption for an overly-conservative assumption makes the difference between an unacceptable risk and a risk that may be acceptable under CERCLA. This is illustrated by the figure below, which was adapted from Figure 7-1 in the May 2, 2011 BHHRA draft (Kennedy/Jenks Consultants 2011).



Adapted from Figure 7-1 in LWG RI Appendix F, dated May 2, 2011

This figure[1]—which shows the range of risk for the CT Scenarios, or the scenarios most representative of an "average" exposure—illustrates that the specifics of the scenarios, and the chemicals themselves, contribute to a huge risk range for each medium. For instance, in the above graph, the difference in risk from ingestion of fish tissue fillets (indicated by the bar labeled "Fish Tissue, F") spans three orders of magnitude, depending on what type of fish or a mix of fish is assumed, among other assumptions. Additionally, most risk pathways—including fish tissue consumption for the general population—exist in a continuum from potentially "acceptable" risk (less than or equal to 10^{-4} excess lifetime cancer risk) to unacceptable cancer risk (greater than 10^{-4} excess lifetime cancer risk).

The fact that varying assumptions make orders of magnitude differences in risk conclusions is extremely significant when carried forward into remedial alternative evaluations and Records of

[1] Figure indicates risk range by media type. Tribal Fish Tissue, WB indicates fish tissue assuming a multi-species diet, eating the entire fish, and using tribal consumption rates over a longer duration than the general population. Tribal Fish Tissue, F is the same as above, but assumes that fish is filleted. Fish Tissue, F indicates fish tissue, both multi- and single-species diets, assuming fish is filleted, whereas Fish Tissue, WB indicates both a multi- and single-species diet, but fish is eaten whole.

Decision (RODs). USEPA will need to make risk management decisions for the ROD that weigh the reasonableness of the purported risk and the ability of the remedy to address the risk.

3.2 The BERA Document was Complicated by the Same Unrealistic Assumption

PCBs are the most significant contributor to unacceptable ecological risk in the Portland Harbor Study Area to receptors including benthic invertebrates, birds, and mammals, with varying risks between these receptors. Generally, for benthic invertebrates and birds, the areas within the Site posing unacceptable risk were limited, or the magnitudes of the Hazard Quotient (HQ) exceedances, a measure of toxicity, were small. For mammals, however, PCBs were calculated to be a significant source of risk at the Site. Because of this potentially significant risk, it is important to assess the highly conservative assumptions that have generated unacceptable risk outcomes for mammals and for mink in particular. Two example assumptions believed to be both excessive and unrealistic are discussed below. These are illustrative of how conservative assumptions used in the risk calculations are not realistic and lead to unacceptable conclusions about risk.

First, mink are assumed to feed exclusively on older, larger fish such as carp that have likely accumulated more contaminants in their tissues; however, the diet of the mink is driven entirely by the variety of prey they are able to catch, which typically includes small fish, herbivorous water birds, small mammals, and invertebrates. In the wild, mink rarely grow to weigh more than a few pounds (the BERA assumed an adult weight of about 1 kilogram), while an adult carp can weigh many times that. As an example, the average mink size is 50 to 60 centimeters (cm), and the target length of carp caught for the Portland Harbor risk assessments was 50 to 60 cm—the carp are therefore as large as the mink. Mink would not be capable of feeding exclusively on such large fish, all caught within the Portland Harbor Study Area.

Additionally, the BERA assumes that the mink resides and eats prey caught exclusively *within* the Portland Harbor Study Area waterway; however, normal mink behavior would be to forage primarily on land along waterways as well as within the waterway itself. It is not expected that a mink population would be constrained solely in the Portland Harbor Study Area. Mink require a much larger area to survive, and would therefore forage within and outside the Portland Harbor Study Area, particularly uplands.

3.3 The Calculation of Site Background was Overly-censored by USEPA, Resulting in Unreasonably Low Background Levels for Key Chemicals

At many CERCLA sites, various sources may be contributing to the contamination. Sources may include releases within the site itself or contamination originating from other sources, including naturally-occurring substances and/or anthropogenic (man-made) sources outside the site area. Substances present that are not attributable to anthropogenic releases at the Site under investigation are known as “background” concentrations (USEPA 1995, 2002b). Since background concentrations are not attributable to the Site itself, CERCLA guidance does not require that sites be cleaned to levels less than background (USEPA 2002b).

The calculation of background concentrations is a significant issue at the Site. Water continuously flows into the Site from upstream, carrying with it sediments from the upstream riverbed. As at many river sediment sites, the water and sediments flowing into the Site from off-site sources include various substances, including some that are likely naturally-occurring and others that may have originated from upstream, anthropogenic sources. Given the overly-conservative assumptions in some of the risk scenarios in the BHHRA and BERA as

discussed above, even the background concentrations at the Site could be characterized as posing purported human health and ecological risks. As a result, unless a more reasonable approach is applied to assessing the risks at the Site, the risk-based calculations could result in cleanup levels less than background concentrations for some substances. Since CERCLA does not require a site to be cleaned up to levels less than background, the background calculation could become the *de facto* target for cleanup levels at the Site.

At this Site, however, the background concentrations for key chemicals have been calculated at unreasonably low levels as a result of certain directives from USEPA. These directives relate to the area sampled for background data and the exclusion of specific sampling results from the dataset.

3.3.1 The Portland Harbor Background Calculation Improperly Excludes All Sediment Data from the Portions of the River Immediately Upstream of the Site

The background calculations at the Site are presented in the draft Portland Harbor RI Report. These background levels were calculated based on the LWG's surface sediment data collected between River Mile (RM) 15.3 and RM 26, combined with surface sediment data between RM 15.3 and RM 28.5 (several miles upstream of Willamette Falls) from four non-LWG investigations occurring between 1999 and 2007. The draft Portland Harbor RI Report states that the reference area for background of RM 15.3 to RM 28.5, "...was chosen because it is considered broadly representative of the urban and suburban upland conditions along the banks of the LWR as it flows through Portland and its suburbs, but upstream and uninfluenced by releases from the Portland Harbor Site" (Integral Consulting, Inc. et al. 2009).

In fact, the area selected for sediment sampling of purported "background" concentrations is not representative of the concentrations entering the Site from upstream. In limiting this area to RM 15.3 to RM 28.5, USEPA required the LWG to ignore RM 11.8 to RM 15.3, which includes the Downtown Portland corridor, a highly-urbanized and industrialized area immediately upstream of the Site boundary.

In excluding the immediately upstream sediments from the background calculation, USEPA noted that the Downtown Portland corridor contains discrete inputs from several historical industrial sites, as well as general inputs associated with urbanization. USEPA therefore concluded that *all* of these sediment data were unacceptable for use as a background reference location for the sediment; however, the fact that the Downtown Portland corridor includes chemical inputs from various sources does not justify a decision to exclude *all* sediment data from this area in the background calculation. Rather, upstream data could have, and should have, been evaluated to identify results appropriate for inclusion in the background calculation dataset. Because any data selected for the background analysis are required to meet stringent data quality requirements, a review of the data from the Downtown Portland corridor should have been performed to identify any outliers that may reflect possible point sources of contamination in this upstream stretch of the river. Any such outliers should have been removed from the dataset, and what remained should have been included in the dataset for background calculations.

The USEPA directive to exclude all sediment data from the area immediately upstream of the Site has significant implications. Sediment samples from the Downtown Portland corridor would be far more representative of the urban background concentrations of the chemicals entering the Site than the sediment data collected far upstream. By excluding all sediment sampling data collected in the Downtown Portland corridor from the background dataset, USEPA skewed the

background calculation, lowering the levels calculated to concentrations less than those found in sediments immediately upstream of the Site.

3.3.2 Even for Data Collected Further Upstream, the Portland Harbor Background Calculation Improperly Excluded Higher Data Points Without Sufficient Basis

After excluding all sediment data from the area immediately upstream of the Site, USEPA then skewed the PCB background calculation further by directing the LWG to remove the higher PCB data points in the sediment samples collected further upstream. In all, USEPA required the LWG to remove four data points with higher concentrations of PCBs.

In directing the removal of these data points from the background dataset, USEPA asserted that these elevated levels may be associated with specific sources; however, USEPA did not provide any evidence justifying their exclusion as "outlier" data. For example, USEPA did not identify any specific sites, perform any notifications of potentially responsible parties, or document releases near these sampling locations. The only rationale cited by USEPA in directing the exclusion of this data was the proximity to the shoreline of these particular sampling locations.

USEPA's directive to exclude these four data points dramatically lowered the background calculation for PCBs. Ultimately, background calculations for PCBs ranged from 6.9 ppb to 50.8 ppb—a seven-fold range in concentrations based on the exclusion or inclusion of specific data points and specific statistical approach. In light of the scale of the RI/FS, the inclusion or exclusion of a few samples should not cause such a swing in the potential background values to be applied at the Site. Given USEPA's censoring of the dataset, however, the sample size was reduced to the extent that removing even four data points dramatically reduced the background calculations to these unreasonably low levels.

3.3.3 USEPA's Over-censoring of the Dataset for the Background Calculation has Resulted in Background Levels That are Unjustifiably Low

As a result of the exclusion of all sediment data from the Downtown Portland corridor and the removal of select data collected further upstream, the background concentrations calculated for key substances at the Site are extremely low. For example, based on the mandate from USEPA, the "final" background level for PCBs has been set at only 17 ppb, USEPA's selected value. These unreasonably low background level calculations could undermine the goals of the remedy selection process.

For example, if background concentrations are used as targets for the cleanup levels at the Site, the levels calculated for PCBs and other key substances based on USEPA directives may result in cleanup levels that are so low that they will not be technologically achievable. Even after any remedial actions are performed at the Site, sediments will continue to enter the Site from the upstream Downtown Portland corridor with concentrations of various substances greater than the background levels calculated based on USEPA's directives. If the background target concentrations are set lower than the concentrations of sediments upstream, these upstream sediments will be carried downstream. When combined with ongoing, low-level urban inputs, these upstream sediments will rapidly "recontaminate" the post-remedial sediment surface. Ordinarily, such "recontamination" would be viewed as an apparent failure of the sediment remedy. Here, however, any "recontamination" from the upstream sediments would result solely from USEPA's directives setting unrealistic background target concentrations based on the selective removal of valid data. This likely recontamination from upstream sources calls the

permanence of any selected remedial action into question, a key factor in the remedy selection process.

In fact, the background concentrations for some key contaminants when calculated based on USEPA's directives are even lower than the detection limits for a substantial portion of the data collected at the Site. For example, approximately one quarter of the calculated dry weight background values for total PCBs are less than 30 ppb. Detection limits for total PCBs in data collected prior to sampling for the Portland Harbor RI were generally around 30 to 35 ppb. Therefore, the current PCB "background" level of 17 ppb is much *less* than the detection limits of older PCB data used in the Portland Harbor dataset.

4.0 KEY FS COMPONENTS WERE DICTATED BY USEPA WITHOUT SUFFICENT EXPLANATION OR JUSTIFICATION

4.1 Extremely Low PRGs Were Selected for the Site by USEPA Without Sufficient Explanation or Scientific Justification

As noted above, PRGs are critical criteria in the FS process. During the FS process, PRGs are converted into remediation goals and RALs. As precursors to the ultimate cleanup standards (or criteria) used at a site, PRGs and subsequent RALs are key tools for the process leading toward the final remedy selection. The LWG first proposed a PRG development process in a January 20, 2005 Technical Memorandum. In this memo, the LWG proposed that initial PRGs be developed and finalized near the completion of the RI and risk assessment process. At that time in 2005, the LWG noted that background concentrations, the food web model, human health risks identified in the BHHRA, and ecological risks identified in the BERA were all important factors to be evaluated in the development of PRGs (Anchor Environmental, LLC et al. 2005).

A July 24, 2008 USEPA document, *Confirmation of PRG Agreements in Principle* (USEPA 2008), describes development of PRGs. USEPA agreed "in principle" to a list of early PRGs that the LWG had presented to USEPA; however, USEPA outlined methods for the LWG to follow in subsequent PRG development. In a series of documents, early PRGs were proposed based on specific USEPA instructions. The refinement process began later that year, and on December 10, 2009 the LWG published a list of all PRGs to date. This list was further refined in a series of meetings between USEPA and LWG beginning in March 2010. A second list, published March 24, 2010, identifies USEPA Focused PRGs that must be used in the FS process. These PRGs developed for use in the FS represent a variety of risk levels (10^{-4} to 10^{-6}) for multiple endpoints (fish consumption, direct contact with sediments, etc.) including many contaminants.

Despite the duration of the refinement process and the extent of submissions by the LWG, the ultimate PRGs were set by USEPA with little explanation or justification. In fact, the line of evidence is very weak for some PRGs, with little indication in the record as to the process used by USEPA to derive these values. Some PRGs appear to be borrowed arbitrarily from other guidance or regulatory programs (e.g., the National Oceanic and Atmospheric Administration's [NOAA's] Screening Quick Reference Table [SQuiRT] values) without any apparent reference to site-specific information from the extensive RI/FS process (such as the applicability of selected SQuiRT values to the existing Willamette River benthic community).

Many of these PRGs set by USEPA are extremely low and, in some cases, much less than laboratory detection limits. If these low PRGs are used as targets for the ultimate cleanup levels, the remedy would not be technologically achievable for the reasons outlined above.

4.2 The AOPCs at the Site Were Derived by USEPA Without Sufficient Explanation or Scientific Justification

During the RI process, AOPCs at the Site were identified for use in the FS. AOPCs are subparts of a site that define the extent of impacted sediments within which active remedial technologies may be evaluated. AOPCs, therefore, focus the FS process and provide a starting point to assess the extent of the potential remedy. In all, 26 AOPCs have been identified for use in the FS. AOPCs are, therefore, a critical component of the FS, and the identification of AOPCs and their boundaries is a key decision in the FS process.

Once again, however, a critical decision at the Site was made by USEPA with little explanation or scientific justification. In fact, the AOPCs currently in use at the Site were derived by USEPA and given to the LWG for its use without any significant explanation. Unfortunately, it does not appear that USEPA documented their rationale or process for AOPC derivation in any materials available in the record. Others are, therefore, left to speculate as to how the AOPCs were identified and their boundaries set. As a result, it is unclear if the AOPCs used in the FS process are supported by sufficient site-specific information or based on any scientifically-defensible criteria. Since the AOPCs in effect drive the scope of the remedial evaluations, the rationale must be transparent and technically defensible.

5.0 PORTLAND HARBOR IS OUT OF ALIGNMENT WITH SEDIMENT SITES NATIONALLY AND ALREADY IS CLEANER, IN ITS PRE-REMEDIATION STATE, THAN MANY OTHER SEDIMENT SUPERFUND SITES

The excessive conservatism in the risk assessment process, calculation of background, and development of PRGs as described above has had a cumulative effect of pushing the project out of alignment with other CERCLA sediment sites. Because the FS is in development and the likely remedial extents (other than AOPCs) have not yet been determined, a good metric to illustrate this overly-conservative approach at Portland Harbor is to compare sediment concentrations at the Site to RALs at other national sediment Superfund sites.

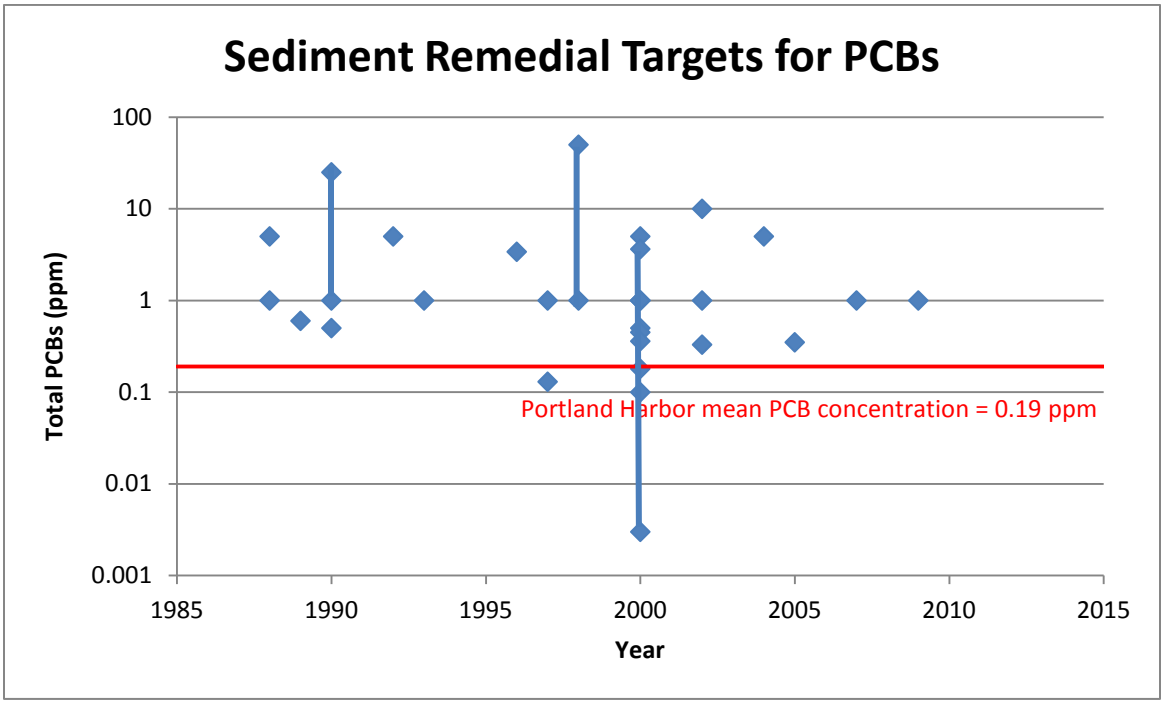
As noted above, PRGs are an important step in the ultimate development of RALs, which, in turn, constitute a critical component of the FS process, defining an action level greater than which a remedial action will be taken. In deriving RALs from PRGs, it is necessary to consider both risk reduction and time, among other factors, to achieve the remedial goal. The PRG to RAL process is critical to narrow the focus to key contaminants and evaluate the protectiveness of the remedy for key risk pathways. In general, RALs are always higher than PRGs. At Portland Harbor, however, the PRGs (as directed by USEPA) are so low that the RALs for many substances will need to be orders of magnitude greater than the PRGs.

To determine whether Portland Harbor is off-track and out of alignment with other CERCLA sites, the sediment concentrations reported in the Portland Harbor BERA and PRGs were compared to RALs identified in the RODs for sediment sites with PCBs, PAHs, or DDX. The goal of this comparison is to evaluate site data and compare site RALs to USEPA-implemented remedies at other sites.

The findings demonstrate that the use of overly-conservative assumptions at the Site would lead to the selection of RALs that are inconsistent with other USEPA sediment projects. In fact, RALs implemented by USEPA at other sites are, in some instances, *greater* than current, pre-remedial Portland Harbor sediment concentrations, meaning that Portland Harbor is already cleaner pre-remediation than other post-remedial sediment sites. A detailed comparison is provided

below; the data used are from a compilation of major sediment Superfund sites compiled by the USEPA CSTAG[2]:

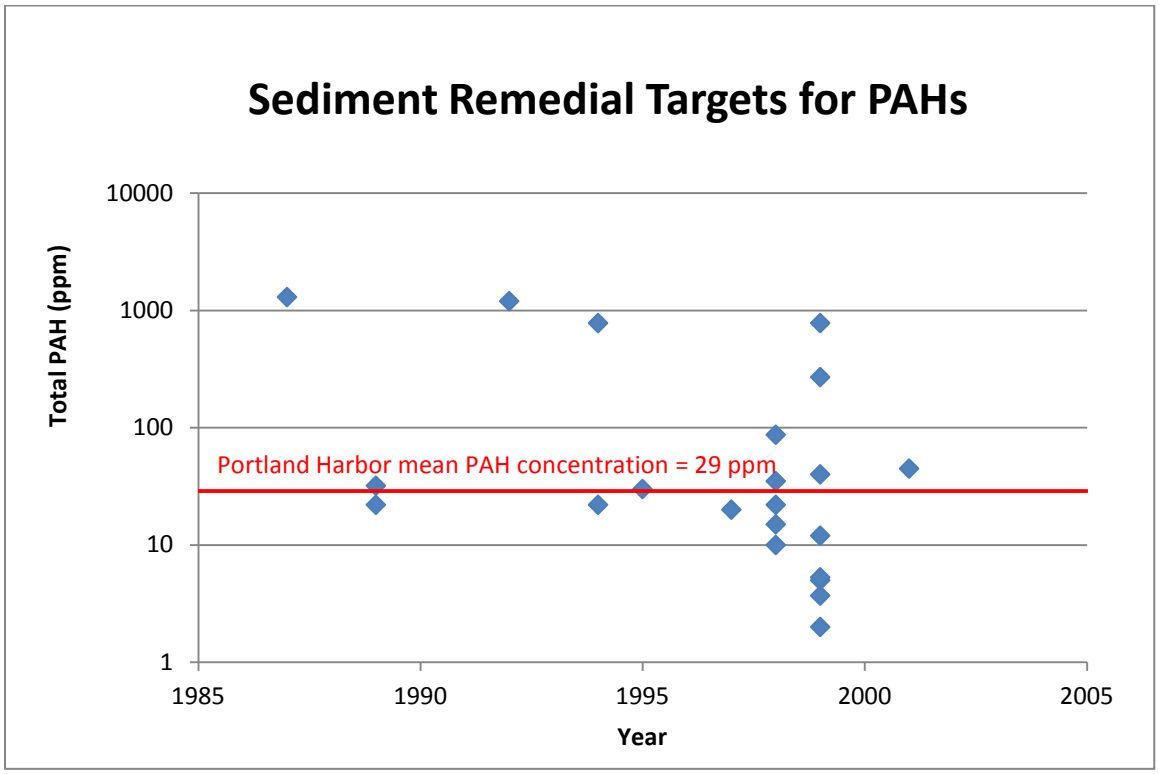
- PCB cleanup levels identified for sediments at other Superfund sites have ranged from 130 to 50,000 ppb (refer to figure below, which depicts total PCB cleanup levels in parts per million [ppm]). Notably, Portland Harbor baseline PCB sediment concentrations, which range from 51 to 30,800 ppb, are *less* than or within selected cleanup levels at other Superfund sites (for instance, the Housatonic cleanup level is 1 ppm, the Hudson River dredge residual standard is approximately 1 ppm, and the Lake Hartwell cleanup level is 25 ppm total PCBs). The average detected concentration of 190 ppb (0.190 ppm) in Portland Harbor is *less* than all but one of the cleanup levels identified. This mean concentration of 190 ppb is driven by a few elevated concentrations; the median PCB concentration is much lower. Because PCBs were only detected in 840 of 1,100 surficial sediment samples, the true site average is likely less than 190 ppb. Therefore, eliminating areas with elevated PCBs will effectively reduce the risk in Portland Harbor (USEPA 2011).



- PAH cleanup levels identified for sediments at other Superfund sites have ranged from 2 to 1,300 ppm (refer to figure below—note that these cleanup levels are based on "total PAH" cleanup levels or, if "total PAH" cleanup levels were not available, the minimum of individual PAH cleanup levels). Baseline total PAH concentrations at the Site range from 0.0063 to 7,300 ppm, with an average detected concentration of 29 ppm. Again, like PCBs, the presence of a few elevated values results in a mean concentration much larger than the median concentration for the Site. Using the mean concentrations still results in a site concentration *less* than many USEPA

[2] Major sediment sites are defined as greater than 10,000 cubic yards dredged or greater than 5 acres capped or greater than 5 acres monitored for natural recovery (USEPA 2011).

selected RALs at other sediment Superfund sites (e.g., Lavaca Bay at 44.8 ppm and the Wyckoff Eagle Harbor Site of 750 ppm [USEPA 2011]).



- DDX cleanup levels identified for sediments at other Superfund sites range from 5 to 19 ppm. Baseline total DDX concentrations at the Site, which range from 0.00013 to 16 ppm, are less than or within cleanup levels at other Superfund sites, and the average detected concentration of 0.13 ppm is much less than the minimum cleanup level established for *any* sediment site nationwide. Examples include the Velsicol Pine River Site, with a cleanup level of 5 ppm, and the Baird and McGuire Site at 19 ppm (USEPA 2011).

Based on the above comparisons, it is apparent that the in-situ sediment concentrations of PCBs, PAHs, and DDX in the sediments in Portland Harbor are, in the current non-remediated state, within the range of concentrations that have been approved by USEPA for *final* cleanup levels at other sediment sites. In addition, the proposed PRGs in use for the FS process are extremely low in comparison to USEPA RALs developed for other sites—in many cases, orders of magnitude lower.

This comparison demonstrates that the overly-conservative risk assessment assumptions and background calculations could result in remedies that are inconsistent with sediment remedies selected at other Superfund sites unless USEPA makes more realistic risk management decisions. Without such realistic decisions, Portland Harbor would be saddled with unreasonable RALs far lower than the levels attempted at any other site in the nation. In that event, the prospects for successfully implementing sediment remedies that could effectively and efficiently remediate the sediments to the proposed target sediment concentrations would be extremely low. Even if a remedy could be devised to achieve these unprecedentedly low

cleanup levels, the remedy would likely fail long-term, particularly given the drastic source control measures that would be required to reduce the risk of the inevitable recontamination.

As noted below, USEPA Headquarters and CSTAG should conduct a review of the Site as soon as possible in advance of the ROD. CSTAG could specifically evaluate the feasibility of reaching the proposed RALs that are developed in the FS process for potential effectiveness and implementability. Relative cost to marginal protection of human health and the environment should be carefully considered in subsequent steps of the FS to ensure that the final remedy selection takes into account the Site setting and multiple source control issues, protects health and the environment in a cost effective manner, and is in line with remedial actions at other sediment sites.

6.0 PORTLAND HARBOR IS A KEY ECONOMIC ASSET TO THE REGION

The Willamette and Columbia Rivers have always been central to Portland's economy and Portland has grown alongside and because of its working rivers. Today the Willamette and Columbia Rivers not only provide ecological systems, recreational opportunities, and real estate amenities, they are also essential parts of the working economy of the Portland metropolitan area (Abbott 2008).

Portland Harbor, long a working harbor with extensive dredging and channelization, is an economic engine that has been the source of jobs and growth for the Portland metropolitan area for over a century. Portland's working harbor is Oregon's largest seaport, where a deep-water channel, rail, pipeline, and highway infrastructure merge. Portland Harbor contributes to the local, regional, and national economies by providing employment and income to individuals, tax revenues to local and state governments, customs fees to the Federal Government, and revenue to businesses (Working Waterfront Coalition 2011). Per Portland's master planning process, it will continue to be a working harbor in the future.

Portland Harbor consists of public and private marine terminals. The Port of Portland's public marine terminals include Terminal 6, which is the primary ocean container terminal handling both automobiles and breakbulk; Terminal 2, which handles breakbulk cargoes and steel; Terminal 4, which handles bulk products as well as breakbulk cargoes and automobiles; and Terminal 5, which handles grain and mineral bulks. Private marine terminals within Portland Harbor handle grain, petroleum products, and dry bulk cargoes such as cement, alumina, sand, gravel, and limestone (Martin Associates 2007).

In calendar year 2010, more than 17,000 jobs in the Portland metropolitan region were supported by activity in Portland Harbor. The businesses providing maritime services in Portland Harbor received over $1 billion of direct business revenue and provided over $1 billion of personal wage and salary income as well as local consumption expenditures to the region. The average annual salary of these jobs is over $50,000 (Martin Associates 2011), which is greater than than the Portland area's average household income of $47,657 (Oregon Employment Department 2010). In addition, over $134 million of state and local tax revenue was generated by maritime activity in Portland Harbor in calendar year 2010 (Martin Associates 2011).

With business, trade, and employment in the harbor projected to grow, Portland Harbor remains an economic driver for the region. A plan is needed that supports cleanup efforts but also helps retain and create new jobs, thereby contributing to the region's economic viability.

Given the economic importance of Portland Harbor to the region, an overly-conservative and expensive remedy designed to achieve unprecedentedly low cleanup levels could burden not only the harbor, but the entire region, with unnecessary direct costs and unforeseen indirect economic impacts for decades. This additional, yet unquantified cost should be considered when USEPA makes risk management decisions for the Site.

The potential costs and economic impacts of a remedy at Portland Harbor may include the following:

- Direct costs attributed to the Superfund process, including investigatory and remedial costs incurred by businesses as well as public entities such as multiple state agencies, the City of Portland, and the federal government.
- Negative impact on land values, impediment to property transactions, and uncertainty regarding potential development and redevelopment opportunities for waterfront properties or properties with connectivity to the City of Portland.
- Increased operational costs for active facilities (compliance with source control and operations and management requirements and complications for post-remedy maintenance such as dredging).
- Loss of jobs or decreased wages for individuals resulting from businesses leaving the region, scaling back operations, or foregoing growth or investment opportunities given costs and uncertainty associated with the Site.
- Increased costs for citizens via special fees (sewer, etc.) required to fund cleanup and related source control work.

Importantly, the above economic costs and impacts must be disclosed to and evaluated by USEPA, other governmental entities, and the public.

Ultimately, community acceptance of the Portland Harbor remedy will be key to its success. If the community views the preferred alternative as creating an undue burden, imposing costs that are out of alignment with other sediment sites, jeopardizing the future of the seaport and current and future waterfront industries, or saddling the citizens with additional taxes and fees, the community will not accept the remedy as reasonable, which would undermine the prospects for success. If, however, an informed community understands the costs and benefits of the remedy and supports the balance struck between these considerations, the remedy will have a much greater chance of achieving its goals.

7.0 CONCLUSION

For the reasons outlined above, immediate action by USEPA senior management is needed to ensure that the FS and remedy selection process achieve the goals of protecting human health and the environment through technologically achievable and sustainable means without imposing unnecessary burdens on the community. The remedy must be an achievable remedy based on scientifically-defensible, site-specific information. None of these issues would require USEPA to redo any component of the RI/FS. Rather, by focusing on the more defensible scenarios during the risk management process, USEPA can still ensure that the Site remedy is reasonable, achievable, and sustainable.

Toward that end, USEPA Headquarters and CSTAG also should commence an immediate review of the Site. As the group charged with encouraging national consistency at complex

sediment sites, CSTAG is uniquely well-suited to help ensure that USEPA's approach in setting cleanup levels and evaluating remedial alternatives is consistent with its approach at other sediment sites. Given the significance of the issues summarized above, immediate involvement by CSTAG is necessary to ensure that its conclusions are adequately addressed during the current FS process. In that effort, CSTAG should coordinate directly with both USEPA and designated representatives of the interested parties, and USEPA must thoroughly consider CSTAG's recommendations.

8.0 REFERENCES

Abbott, Carl. 2008. *Portland's Working Rivers: The Heritage and Future of Portland's Industrial Heartland*. Prepared for the Working Waterfront Coalition. January.

Anchor Environmental, LLC; Integral Consulting, Inc.; Kennedy/Jenks Consultants; and Windward Environmental, LLC. 2005. *Portland Harbor RI/FS Process for Derivation of Preliminary Remediation Goals (PRG) Technical Memorandum*. Prepared for the Lower Willamette Group. 20 January.

Integral Consulting, Inc.; Windward Environmental, LLC; Kennedy/Jenks Consultants; and Anchor QEA, LLC. 2009. *Portland Harbor Superfund Site Draft Remedial Investigation Report*. Prepared for the Lower Willamette Group. 27 October.

Kennedy/Jenks Consultants. 2011. *Draft Portland Harbor RI/FS Appendix F: Baseline Human Health Risk Assessment.* Prepared for the Lower Willamette Group. 2 May.

Martin Associates. 2007. *The Local and Regional Economic Impacts of the Portland Harbor*. Prepared for the Port of Portland. 31 January.

———. 2011. *The Economic Impact of the Portland Harbor, 2010*. Prepared for the Port of Portland. 8 July.

National Research Council (NRC). 1994. "Science and Judgment in Risk Assessment." Committee on Risk Assessment of Hazardous Air Pollutants, Board on Environmental Studies and Toxicology, Commission on Life Sciences. National Academy Press, Washington, DC.

Oregon Employment Department. 2010. Portland PMSA, "Oregon Portion 2010 Covered Employment and Wages Summary Report." http://www.qualityinfo.org/olmisj/CEP?action summary&areacode=56006441&indtype=N&periodcode=01002010&submit=Continue. Last accessed September 2, 2011.

Oregon Fish and Wildlife (ODFW). 2011. *Division 056, Importation, Possession, Confinement, Transportation and Sale of Nonnative Wildlife, OAR 635–056–0050, Prohibited Species*. June.

Skea, J.C., H.A. Simonin, E.J. Harris, S. Jackling, J.J. Spagnoli, J. Symula, and J.R. Colquhoun. 1979. "Reducing Levels of Mirex, Aroclor 1254, and DDE by Trimming and Cooking Lake Ontario Brown trout (*Salmo trutta* Linnaeus) and Smallmouth Bass (*Micropterus dolomieui* Lacepede)." *Journal of Great Lakes Research* Vol. 5(2):153–159.

U.S. Environmental Protection Agency (USEPA). 1989. *Risk Assessment Guidance for Superfund, Volume 1, Human Health Evaluation Manual (Part A), Interim Final*. Office of Solid Waste and Emergency Response, USEPA/540/1-89/002. December.

———. 1995. Engineering Forum Issue Paper. *Determination of Background Concentrations of Inorganics in Soils and Sediments at Hazardous Waste Site*s. R.P Breckenridge and A.B. Crockett, Office of Research and Development, Office of Solid Waste and Emergency Response, Washington, DC. USEPA/540/S-96/500.

_____. 1997. *Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories.* Volume 2: Risk Assessment and Fish Consumption Limits. 2nd edition. USEPA 823-B-97-009. July.

———. 2002a. *Estimated Per Capita Fish Consumption in the United States*. USEPA 821-C-02-003. August.

———. 2002b *Role of Background in the CERCLA Cleanup Program*. OSWER 9285.6-07P. USEPA, Office of Solid Waste and Emergency Response. Washington, DC.

———. 2008. *Confirmation of PRG Agreements in Principle*. USEPA. 24 July.

———. 2011. "List of Sediment Sites with Substantial Contamination." http://www.epa.gov/superfund/health/conmedia/sediment/sites.htm. Last accessed September 2, 2011.

Working Waterfront Coalition. 2011. http://www.workingwaterfrontportland.org. Last accessed September 2, 2011.

Zabik, M.E., Booren, A., Zabik, M.J., Welch, R., and Humphrey, H. *Pesticides residues, PCBs and PAHs in baked, charbroiled, salt boiled and smoked Great Lakes lake trout.* Food Chem., 55:231-239, 1996.